SUSCEPTIBILITY OF *STAPHYLOCOCCUS AUREUS* NOSOCOMIAL ISOLATES IN RUSSIA: FIVE YEARS TRENDS

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Abstract

Objectives

Staphylococcus aureus is a common nosocomial pathogen. Appropriate initial antimicrobial therapy based on data of local susceptibility pattern is cruicial for outcome. The aim of the study was to evaluate antimicrobial susceptibility trends of nosocomial *S. aureus* strains in different regions of Russia.

Methods

A total of 1456 clinical strains were collected during multicenter studies (24 cities, 29 centres) in two time periods: 2001-2002 and 2006-2007. Susceptibility of all strains to 14 antimicrobials was performed by CLSI agar dilution method.

Results

Overall, 41.7% of strains were MRSA. Oxacillin resistance rates increased from 33.4% in 2001-2002 to 54.4% in 2006-2007. The most active agents were linezolid and vancomycin to which no resistance was found. The highest percentage of non-susceptible isolates was found to chloramphenicol, ciprofloxacin, erythromycin, gentamycin. Increasing of non-susceptibility rate to fluoroquinolones in 2006/7 in comparison with 2001-2 was the highest.

Conclusion

Linezolid, vancomycin, mupirocin, trimethoprim/sulfamethoxazole and fusidic acid retained good *in vitro* activity against *S. aureus*. Resistance to fluoroquinolones, lincosamides, macrolides, aminoglycosides, tetracyclines, fusidic acid, rifampicin and chloramphenicol was found to be substantially increased.

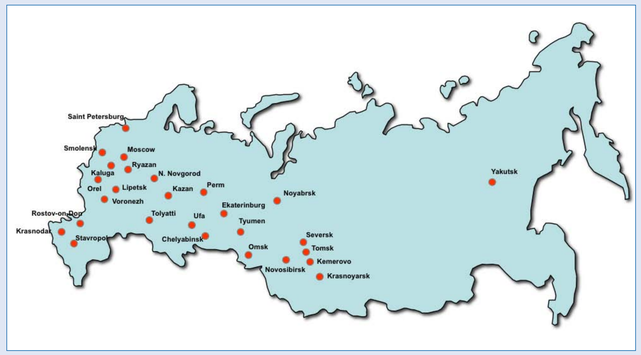
INRODUCTION AND PURPOSE

Staphylococcus aureus is one of the most important pathogens that cause infections in hospitalized patients throughout the world. The resistance of this microorganism in both community and hospital settings to multiple antimicrobials is becoming more and more common. Treatment of infections caused by methicillin-resistant strains of *S. aureus* (MRSA) is one of the main problems of antimicrobial therapy in terms of resistance of this pathogen to all β-lactams and to many other classes of antimicrobials. Such resistance leads to increased mortality and to decrease in cost-effectiveness of treatment. Therefore appropriate initial antimicrobial therapy based on data of local susceptibility pattern is cruicial for outcome. The aim of the study was to evaluate antimicrobial susceptibility trends of nosocomial *S. aureus* strains in different regions of Russia.

METHODS

A total of 1456 clinical strains were collected during multicenter studies in two time periods: 2001-2002 and 2006-2007. Strains were collected from the 29 centres in 24 cities from the following regions: Central (Kaluga, Lipetsk, Moscow, Orel, Ryazan, Smolensk), North-West (Saint Petersburg), Volga region (Kazan, N. Novgorod, Perm, Tolyatti, Ufa), South (Krasnodar, Rostov-on-Don, Stavropol, Voronezh), Ural (Chelyabinsk, Ekaterinburg, Tyumen), Siberian (Kemerovo, Krasnoyarsk, Novosibirsk, Noyabrsk, Seversk, Tomsk) and the Far-East (Yakutsk).

Figure 1. **Geographical distribution of centers, participating in the studies**



All bacterial cultures were delivered to a reference laboratory of Institute of Antimicrobial Chemotherapy (Smolensk, Russia) and re-identified there by standard biochemical methods and stored at -70°C in glycerol broth. The susceptibility testing to chloramphenicol, ciprofloxacin, clindamycin, erythromycin, fusidic acid, gentamicin, levofloxacin, linezolid, mupirocin, rifampicin, tetracycline, trimethoprim/sulfamethoxazole and vancomycin was performed by agar-dilution method using Mueller-Hinton agar (Becton Dickinson, USA). Inoculated plates were incubated in ambient air at 35°C for 24 hours. Interpretation of results was performed in accordance with CLSI recommendations (2008). *S. aureus* ATCC®29213 strain was used for quality control.

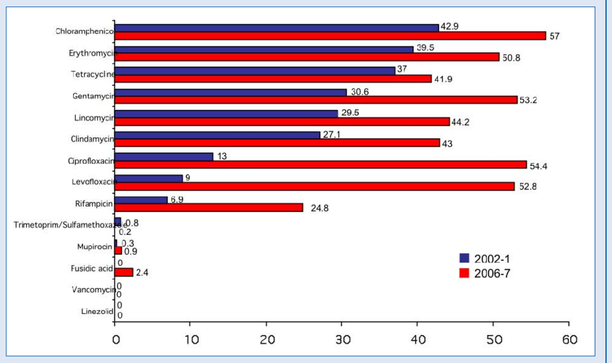
RESULTS

Among all 1456 strains, 41.7% were methicillin-resistant (MRSA). Oxacillin resistance rates have increased from 33.4% in 2001-2002 to 54.4% in 2006-2007. The most active agents were linezolid (MIC_{50} and MIC_{90} 2 mg/l) and vancomycin (MIC_{50} and MIC_{90} 1 mg/l) to which no resistance was found. At the same time, percentage of strains with vancomycin MIC of 0.5 mg/l, 1 mg/l and 2 mg/l were 5.6, 90.7 and 3,7%, respectively. Fusidic acid, mupirocin and trimetoprim/sulfamethoxazole retained good *in vitro* activity. Non-susceptibility rate for rifampicin increased from 6.9 to 24.8%. High percentage of non-susceptible isolates was found to chloramphenicol (42.9 and 57.0 in 2001-2 and 2006-7, respectively), erythromycin (39.5 and 50.8), gentamycin (30.6 and 53.2), clindamycin (27.1 and 43) and tetracycline (37.0 and 41.9). Marked increase in non-susceptibility to fluoroquinolones was noted. Non-susceptibility rates for ciprofloxacin and levofloxacin have increased from 13.0 to 54.4 and from 9.0 to 52.8 in 2001-2 and 2006-7, respectively.

Table 1. In vitro **activity of tested antimicrobials against nosocomial *S. aureus* isolates**

Antibiotic	2001-2002 (n=879)			2006-2007 (n=577)		
	MIC_{50} (mg/l)	MIC_{90} (mg/l)	I+R (%)	MIC_{50} (mg/l)	MIC_{90} (mg/l)	I+R (%)
Chloramphenicol	8	128	42.9	64	64	57.0
Ciprofloxacin	0.5	4	13.0	16	64	54.4
Clindamycin	0.125	256	27.1	0.06	512	43.0
Erythromycin	0.5	256	39.5	1	512	50.8
Fusidic acid	0.125	0.25	0.0	0.06	0.06	2.4
Gentamycin	0.5	256	30.6	64	256	53.2
Levofloxacin	0.25	1	9.0	4	16	52.8
Linezolid	2	2	0.0	1	2	0.0
Mupirocin	0.25	0.25	0.3	0.125	0.25	0.9
Rifampicin	0.03	0.03	6.9	0.015	256	24.8
Tetracycline	0.5	128	37.0	0.5	64	41,9
Co-trimoxazole	0.125	0.5	0.8	0.06	0.25	0.17
Vancomycin	1	1	0.0	1	1	0.0

Figure 2. **Non-susceptibility rates, %**



CONCLUSIONS

- The most active *in vitro* antimicrobials against nosocomial strains of *S. aureus* were linezolid, vancomycin, mupirocin, trimethoprim/sulfamethoxazole and fusidic acid.
- Resistance to β-lactams fluoroquinolones, lincosamides, macrolides, aminoglycosides, tetracyclines, fusidic acid, rifampicin and chloramphenicol was found to be substantially increased during a 5-year period.